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BUILDING ENERGY MONITOR'S

HANDBOOK

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BUILDING ENERGY MONITOR'S HANDBOOK

Table of Contents

	Page
INTRODUCTION	1
CHAPTER 1 THE BUILDING ENERGY MONITOR	2
CHAPTER 2 INFILTRATION	6
CHAPTER 3 VENTILATION	10
CHAPTER 4 HOT WATER	13
CHAPTER 5 HEATING	16
CHAPTER 6 COOLING	22
CHAPTER 7 LIGHTING	26
CHAPTER 8 SPECIALTY BUILDINGS	31
CHAPTER 9 CHECKLISTS	35

INTRODUCTION

The economic and strategic need for a strong Army Energy Program cannot be over-emphasized. Over the last several years, the Department of the Army and the Department of Defense have come up with a large number of energy conservation programs aimed at improving the energy efficiency of buildings. However, energy conservation retrofits are only part of the answer. Energy efficiency through education, awareness and involvement is the key to a successful energy reduction program. The energy reduction goals, set by the Department of the Army, are achievable provided support can be obtained at all levels, from the Building Energy Monitor (BEM) to the Commander.

The purpose of this handbook is to explain to the BEM the various energy consuming components of buildings, how they interact with each other and various ways that energy can be saved during the course of the operation of facilities.

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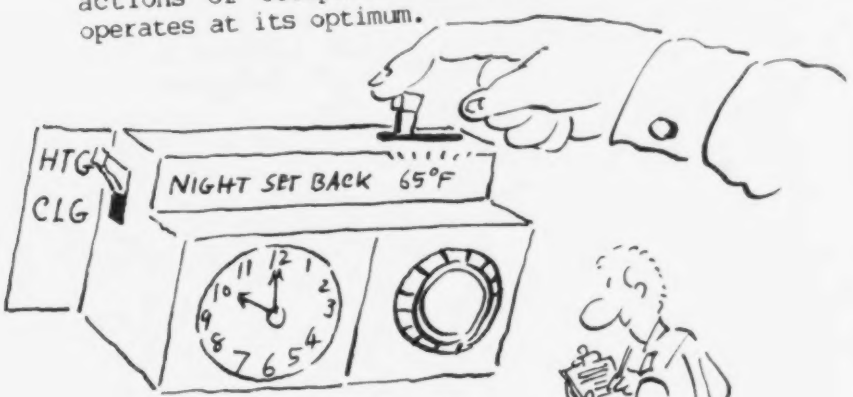
CHAPTER 1

THE BUILDING ENERGY MONITOR

You, as the BEM serve a vital role; you are, so to speak, on the firing line. You are in those facilities that need to be monitored and assessed on a regular basis.

If you are in a building which has been modified to be more energy efficient, it is extremely important to insure that the gains in energy efficiency are not defeated by the actions of occupants and that the building operates at its optimum.



If you are in a building which has not yet been modified, it is important to insure that the building operates as efficiently as possible.

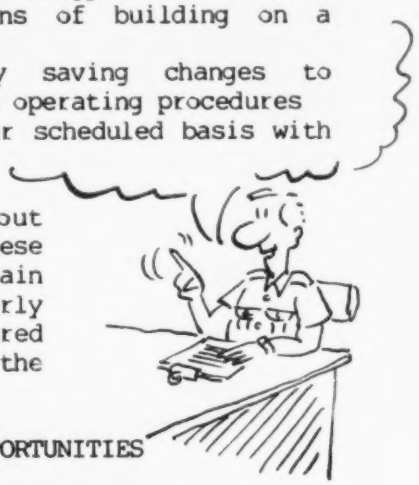
RESPONSIBILITIES

The BEM's primary responsibility is to maximize energy efficiency of the building by coordination with the Installation Energy Coordinator (ENCON): to insure that his or her efforts are in concert with the various programs that the ENCON has instituted and the standard operation procedures of the installation. A team effort will yield far more benefits than individual action.

When initially appointed, the BEM should discuss his or her duties with the appointing officer and the ENCON either on an individual basis or on a group basis with other Building Energy Monitors.

The BEM is a person charged with unit energy conservation and should assume the following responsibilities:

- point of contact for unit energy related matters
- prepare work orders for low cost energy conservation opportunities (ECO's)
- prepare work orders for maintenance items that affect energy conservation
- monitor operations of building on a routine basis
- recommend energy saving changes to building standard operating procedures
- meet on a regular scheduled basis with the ENCON.



The BEM should fill out weekly checklists. These checklists should remain on-file and a quarterly deficiency report prepared and submitted to the ENCON.

ENERGY CONSERVATION OPPORTUNITIES

If an energy conservation opportunity (ECO) is uncovered, you can discuss your findings and recommendations with the ENCON, and perhaps the Directorate of Engineering and Housing (DEH). If the ECO is technically sound, you might be requested to prepare and submit a work order. If the idea requires a large capital investment or is applicable to a broad range of buildings, the ENCON will want to prepare project documentation to obtain funding through one of the various energy conservation funding programs. The checklists and concepts in this handbook will help you get some ideas for these recommendations.

HOW TO CARRY OUT YOUR RESPONSIBILITIES

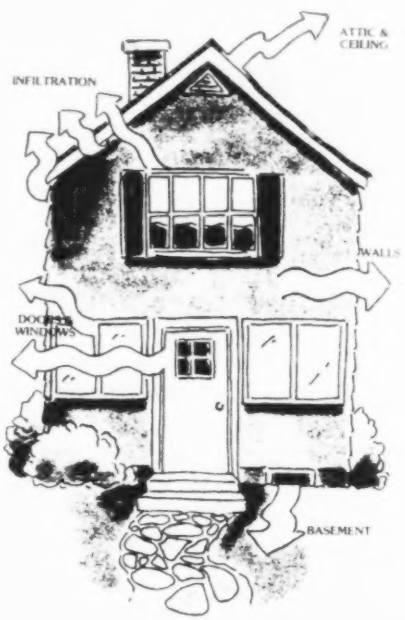
In order to carry out these tasks, you will need to know something about the energy consuming components of a building and how efficiency can be optimized. This handbook will go a long way in helping you understand energy conservation, the nature of energy consumption and the types of things that you should be looking for as you carry out your job.

CHAPTER 2

INFILTRATION

Heat is mainly lost during the heating season or gained during the cooling season by conduction and infiltration. Heat lost or gained by conduction passes directly through the building materials which make up your walls, windows, ceilings, roofs and floors.

Infiltration is heat lost or gained due to outside air entering a building through cracks around windows, doors and through the outside shell of the structure. Not only does it cause discomfort to building occupants, it is a major contributor to unnecessary heating and cooling costs and energy losses.



During the heating season, infiltration contributes to heat loss because cold infiltrated air displaces warm air and must be heated to maintain desired comfort conditions.

During the cooling season, infiltration contributes to heat gain because the warmer infiltrated air must be cooled to maintain desired comfort conditions.

The following suggestions will help reduce the rate of infiltration into your building and the associated energy use:

- Make sure that all doors are closed, especially during the heating and cooling seasons. Post a sign to remind occupants to close doors.

- Make sure that all windows remain closed during the heating and cooling seasons. You might consider placing small signs around the windows instructing personnel not to open them during these seasons.

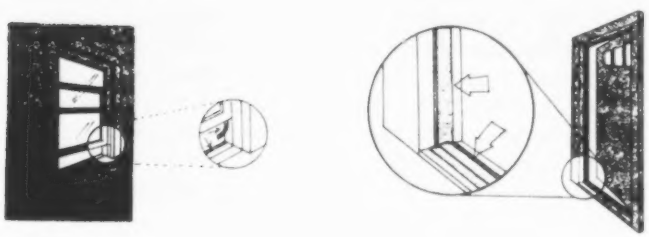
- If your building has any unheated or uncooled spaces, see that doors are closed.

- If your building has a loading dock make sure it's door is closed when not in use.

- If your building does not have dock curtains for unloading, initiate a work order for their installation.

- As you tour your building, you should periodically inspect the weather stripping and caulking. If it is old and dried or peeling, be sure to submit a work order for repairs. If you notice

that there was never any weather stripping or caulking, suggest that it be installed. Some caulking and weatherstripping are self-help. Check with the DEH.



- If the building is drafty, check to see if there is insulation in the attic (if there is one), walls and under the floors if it is above grade. Report your findings to the Base Energy Coordinator. You might then suggest the installation of caulking, weather stripping or storms doors and windows.

- If you see any cracked or missing windows, be sure to submit a work order for their immediate repair.

- If your building has a significant amount of traffic, tell the ENCON that a vestibule or revolving door might be installed to reduce infiltration.

- You may notice cracks in the outside of the building, such as the joint where the foundation meets the siding or wherever exterior walls are penetrated by pipes, ducts and conduits. Be sure that the ENCON is made aware of it so that caulking can be installed.

- If your building has many entrances suggest closing some off - if the fire laws would permit.

- If your building has window air conditioners, make sure that they are covered and vents are closed during the heating seasons.

CHAPTER 3

VENTILATION

Ventilation has a significant impact on a building's total energy consumption. Each unit of air brought into your facility must be heated or cooled and, in some cases, humidified or dehumidified. If excess air, beyond that required for the comfort and safety of your building's occupants, is brought in, a considerable waste of energy is inevitable.

Energy savings arise from reducing ventilation rates and/or shutting off the ventilation system when it is not needed. However you must take some care in looking at these energy conservation opportunities. Because of existing building codes, if you think that possibilities for savings can be realized you must check with the Energy Coordinator to assure that complete analyses are done and legal requirements met.

The following ideas will assist you in seeking savings due to excess ventilation:

- Suggest that ventilation units operate only as needed. Consider shutting them off to any area that will remain unoccupied for more than one hour.

- As you walk through your building, periodically inspect the condition and operation of outside air dampers. Faulty operation or bad fit causes loss of heated or cooled air.

- Suggest to the Energy Coodinator or DEH that the ventilation system be turned off completely during spring and fall months when most occupants will want to use the windows anyway.

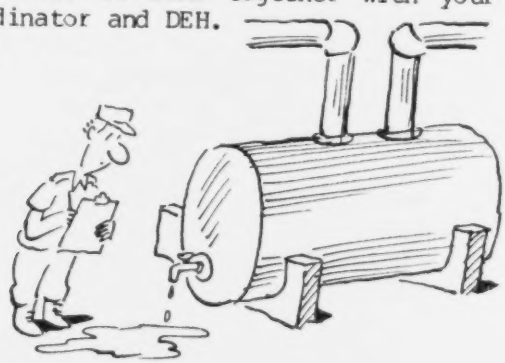
- If you have some rooms in your building that have special ventilation requirements, recommend that time clocks be installed on these systems. This will assure that they are turned off when not in use and yield considerable energy savings.

- Ask the ENCON to investigate the possibility of installing time clocks wired to the lighting in areas such aS toilets so that the fans there do not run all the time.

CHAPTER 4

HOT WATER

Hot water generation and its consumption often accounts for up to 10% of a building's energy use, more if your building has a restaurant, cafeteria or laundry. There are many opportunities for saving energy here, but most will require the installation of new equipment. This work should be done together with your Energy Coordinator and DEH.



As you probably know, the usual temperature at which hot water is supplied is generally too hot to be used directly. Cold water must be mixed with it at the tap. Here then are some possible energy savings:

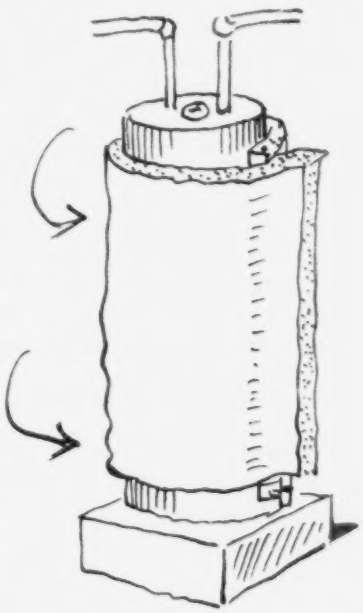
- Suggest to the occupants of the building that, unless health codes prohibit it, they should wash in lavatories with cold water only.

- Check with the ENCON to see if you can get the hot water temperature reduced to about 100°F. If necessary, have the ENCON install boosters where the temperature must be higher--for dishes, laun- dries, etc.

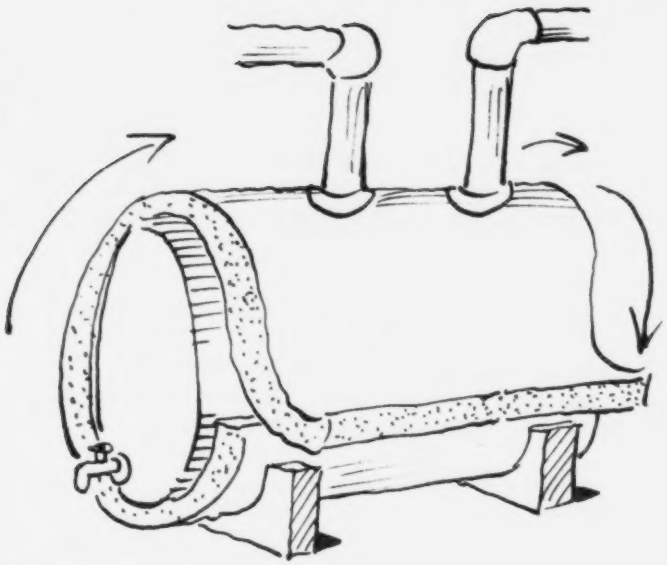
There are many benefits to be gained from reducing the quantity of hot water used: energy savings, of course, but also decreased treatment costs and lower usage payments.

- Suggest that self-closing faucets be installed on hot water taps.

- Look into the possibility of installing spray-type faucets with flow restrictors - this is especially good in showers.



Finally in hot water systems, you will want to improve the efficiency of the overall system. This is best accomplished by:



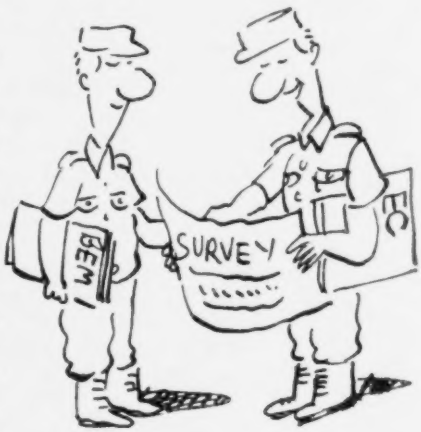
- inspecting and then having insulation repaired on hot water piping and tanks.
- installing insulation on the hot water system, if it does not exist already.
- repairing all leaks, including those at the faucet.
- shutting off hot water pumps when the building is unoccupied.

CHAPTER 5

HEATING

It is in the heating and cooling (see also the next chapter of the manual) systems that most of your building's energy savings can arise. Much of these savings are often developed at the central plant on your installation.

There are many operational items that you should consider keeping in mind: your building is a unique combination of carefully balanced sets of systems--heating, cooling, and ventilating. Therefore the suggestions that follow should be considered as guidelines only and any major changes must be cleared with the Energy Coordinator.



Energy expended to heat your building to comfort level conditions when it is unoccupied - which, actually, is most of the time - is wasted. Save energy by setting back the temperature during these times. Use the following table as a rough guideline for recommending these setbacks:

TYPE OF ROOM	OCCUPIED HOURS TEMPERATURE	UNOCCUPIED HOURS TEMPERATURE
Office space	68°F	55°F
Corridors	62	52
Dead storage	50	50
Cafeterias	68	50
Mechanical rooms	55	50
Occupied storage areas	68	50
Auditoriums	68	50
Computer rooms	65	as required
Lobbies	65	50
Toilet rooms	65	55
Garages	do not heat	do not heat

With these figures as guides, consider the following:

- Suggest that radiators or heating registers be shut off completely in vestibules, corridors, stairwells and lobbies.

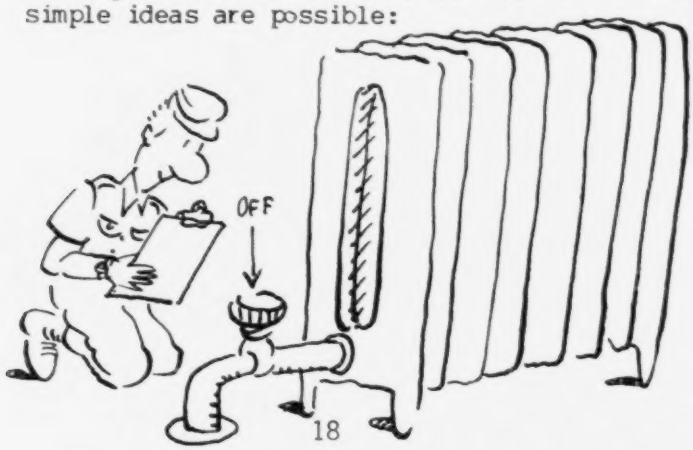
- If your building does not have thermostats that are capable of night setback, tell the ENCON and have them installed.

- If your building is used after-hours, recommend that the number of spaces occupied be very limited to assure that you do not heat the entire building unnecessarily.

- Make sure that the thermostats in your building are tamper-proof. Recommend installing cover locks, if necessary.

- During particularly cold weather, encourage your building's occupants to wear heavy clothing.

The outside conditions can often cause considerable energy loss due to heat escaping through windows and exterior walls. A few simple ideas are possible:



- If the winter sun is shining on a window, take advantage of it and use it to partially heat the room.

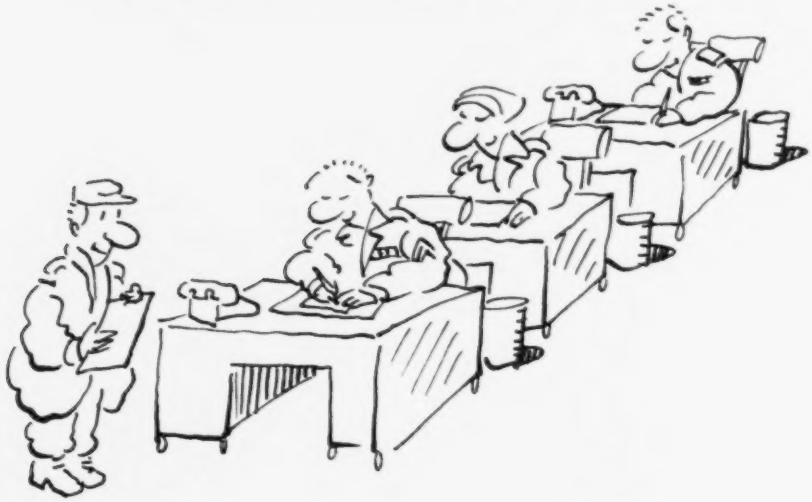
- On the other hand, when the winter sun does not shine on windows, recommend that the occupants draw the drapes, shades or blinds. If these items are not available ask the ENCON to consider installing them.

- Periodically check to see that windows are tightly closed in winter.

- Refer to the section on infiltration to look into weatherstripping and caulking.

- If your building's occupants complain about cold areas, suggest that they rearrange their rooms to place desks away from exterior walls and windows.

- Keep the windows clean to permit maximum sunlight transmission during the winter.



- As you look at the outside of your building, check to see that the foliage is trimmed, especially around the southern, eastern and western walls.

Other means to improve the energy efficiency of your installation often arise from opportunities at the central boiler or power plant. There are some things that you, however, as the Building Energy Monitor, can do to help here:

- If you notice any steam or hot water leaking from the heating system, immediately inform the ENCON. This can mean substantial loss of energy.

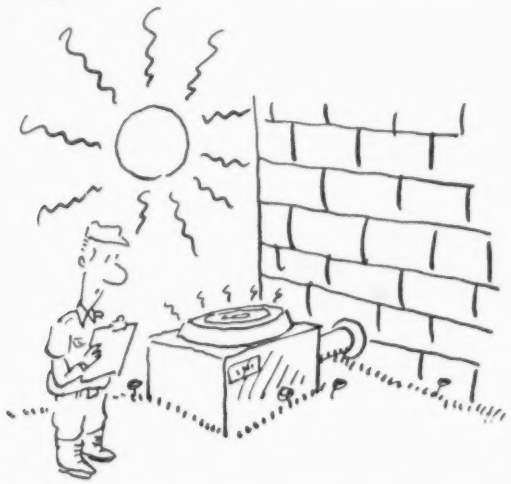
- Check around the radiators of your building; if there are any leaks be sure to report them. But be careful here, the steam escaping can be very, very hot.

- The steam system needs insulation. If you see any missing or in poor repair, submit a work order.

CHAPTER 6

COOLING

Improvements to the cooling system and its operation can save significant amounts of energy. As may be imagined many of the items that work well for conserving energy in the heating system, can also work well for the cooling system.



The object here will be to limit the operational hours of the cooling while yet providing the comfort that your building's occupants need. To do this most effectively you need to know something about recommended cooling temperatures. These guidelines are:

OCCUPIED PERIODS

Type of Area	Minimum Temperature	Minimum Humidity
Offices	78°F	55%
Corridors	uncontrolled	uncontrolled
Cafeterias	75	55
Auditoriums	78	50
Computer rooms	75	as needed
Lobbies	82	60
Toilet rooms	80	uncontrolled
Storage, equipment rooms, garages	uncontrolled	uncontrolled

As with the heating, these temperatures and humidities can provide reasonable guidelines for you as you periodically inspect the building. Other ideas for energy conservation are:

- As you check the air conditioning thermostats, be sure that the above guidelines are not exceeded.
- Make sure the entire air conditioning system is turned off at night and during days when the building is unoccupied.
- If possible try to use outdoor air for cooling. This means being sure that the windows are operable.
- If cool outdoor air is available, consider cooling the building well below normal during the night and early morning hours.

- During the cooling season, windows can work against you. In hot weather, adjust the blinds, drapes or shades to prevent penetration of solar heat into the building.

- If drapes, shades or blinds are not available in your building, check with the Energy Coordinator about having some installed.

- Be particularly careful with a skylight, if your building has one. Treat it as you would a window.

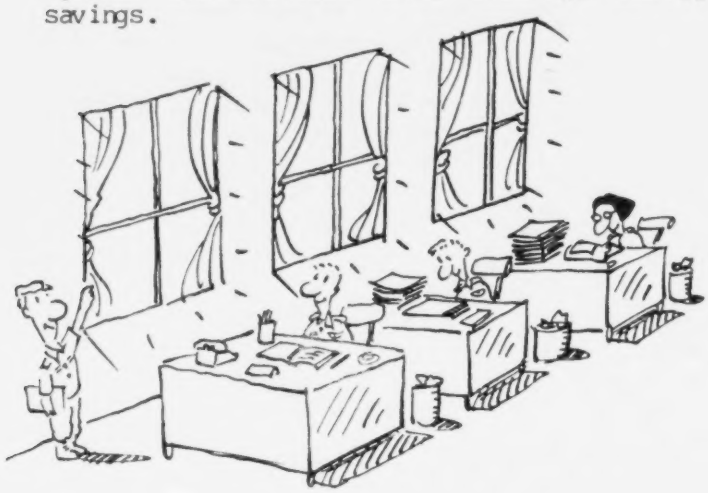
- Ask occupants of your building to turn off air conditioning systems if they plan to be out of their office for a considerable period of time.

- As in the heating system check for leaks and faulty maintenance.

CHAPTER 7

LIGHTING

In most of the buildings on an Army facility, electric lighting is one of the major users of electrical energy. This is due to the fact that many existing buildings were designed without knowledge about final space use and without the benefit of recent developments and research in the field. There exists, therefore, a significant potential for lighting system modifications and, thereby, energy savings.



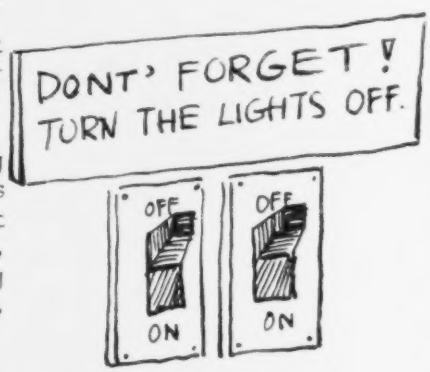
Before making any suggestions, you must recognize that a lighting system is just that -- a system. Its many elements are interrelated. While energy can be conserved by properly implementing the suggestions offered below, you should realize that these actions should

be taken only after you look into the effects on the entire system. It is especially important for you to recognize that major alterations to the lighting system can have impacts on the building heating and cooling system.

There are many possible ways to save on lighting energy. Consider some of the following ideas.

First, and contrary to common belief, it is always better to turn off a light when it is not needed -- even for a short period of time. In view of this "switch it off" policy, you should consider the following:

- Mark all switches so that occupants will remember to turn off the lights.



- Suggest to all building personnel that lights should be out if not needed in storage rooms, vending machines, meeting rooms, bulletin boards, unassigned areas.

- Make sure that building lights are turned off when the facility is unoccupied except those, of course, needed for security.

Another major area for possible lighting savings comes from improving the effectiveness of existing lighting. Most of these savings,

as you will see, arise from proper building maintenance.

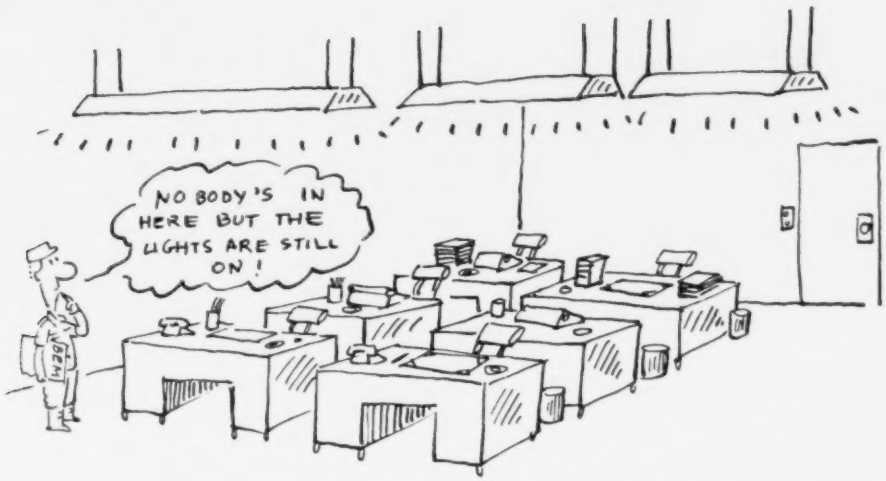
- Suggest that cleaning services regularly clean the lighting fixtures, especially around fluorescent lamps.

- Check the walls of your building to see that they are clean; if not suggest that they be washed.

- If your building is undergoing renovation, suggest to the Energy Coordinator that the walls and floors be decorated with light colors to improve the reflected light.

- If your building has many high partitions, you might look in to the potential for lowering them and "sharing" the light among the occupants.

If possible in your building, suggest to the occupants that they make maximum use of daylight for their lighting. Appropriate use of this source will save electrical energy, decrease the heating requirements and generally not markedly increase the building cooling load.



- To use the daylight, be sure windows and skylights, if any, are clean and cleared.

- Suggest to building occupants that they move their desks closer to windows to take advantage of outside light.

- check blinds, drapes and shades — open them to improve the use of daylight.

Other lighting suggestions will require the assistance of your ENCON. If some of these that follow look like good possibilities for your buiding, ask the ENCON to help with a survey and the detailed calculations that may be eeded:

- In corridors, many lamps can be eliminated without a significant reduction in lighting levels.
- In many areas of a building, storage or corridors, for example — the existing lights can be replaced with those having smaller wattage.
- There are many high efficiency lamps available for use. Suggest that these replace the ones that burn out.
- Suggest to building occupants that they use "task" lighting rather than overall room illumination.

CHAPTER 8

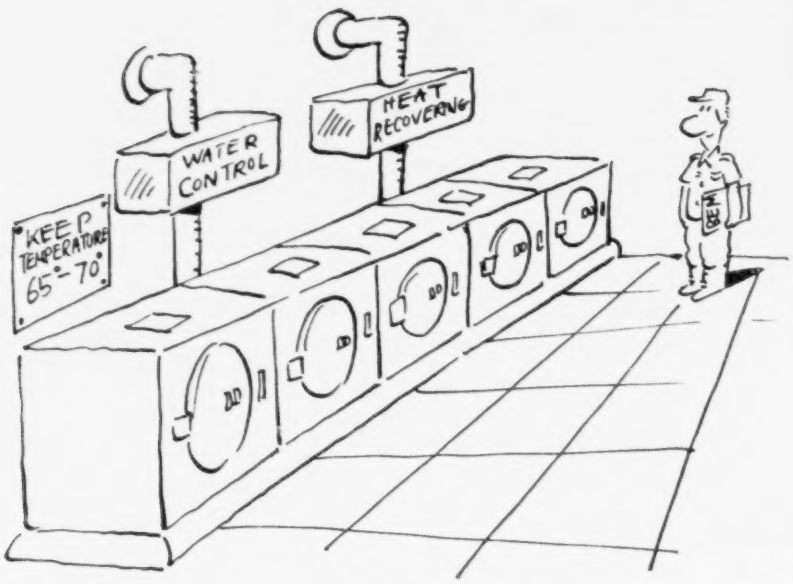
SPECIALTY BUILDINGS

There are many special buildings in the Army inventory which have unique needs and requirements. These include laundries, computer facilities, kitchens, etc. The energy conservation techniques suggested in the preceding sections will, of course, work in these buildings, but some specialized techniques and things to look for are necessary. We discuss some of them in this section.

Laundry

The laundry is obviously a major consumer of hot water for washing and hot air for drying. There are many opportunites for energy conservation but most will require the detailed assistance of the Energy Coordinator. If some of these ideas look feasible to you, be sure to suggest them to the ENCON so that the appropriate analyses can be carried out.

- Combine operations to reduce the number of washers.
- Suggest the use of automatic regulators to control the volume of water used.
- Many laundries have installed heat recovery devices. While these devices have a high capital cost, it is often recaptured with the savings in energy.



- Suggest that the laundry use cold water detergents and keep the temperature down to 65° - 70°.

- Be sure that water filters are cleared regularly. Keep the basket and the working parts of the washer clean for maximum efficiency.

- Suggest that clothes be sorted according to type and soilage, and run washers on the minimum cycle necessary for clothing and degree of soilage. Set timers appropriately.

- Suggest that lint screen and exhaust blowers be cleared at least twice each day.

- Consider using ironing instead of drying whenever possible, as it is more energy- and labor-efficent. Use the extractor cycle and, if needed, partial drying before ironing.

- Minimize warmup time, and run ironers only when actually in use.

Computer Facilities

Computers often need very particular environmental conditions for their efficient operation. However these are often not followed completely. Doing so can save energy for the Base.

- Look into manufacturer recommendations for temperature levels and humidity requirements. Be sure that they are followed.

- If, as is often the case, humidification is used to eliminate shock hazard, shut off the humidifier when shocks are no longer a problem.

- Suggest that lighting levels be reduced to those recommended by the manufacturer.

- As in the laundry, heat recovery may be possible.

Kitchens and Other Similar Facilities

These types of facilites, located throughout the base, are major consumers of energy. Whether they are in the PX or the OClub,

savings can often be developed. Again, analyses will often be required; check with the ENCON.

- Suggest the reduction or possible elimination of humidification.

- Exhaust fans serving kitchens are often interlocked with outside air fans or dampers. Be sure the staff shuts down the entire system when not needed.

- Recommend concentrating smoking areas together to reduce ventilation needs.

- Dishwashers are major consumers of hot water. Often the hot water delivery temperature is set for this equipment. Recommend that the overall temperature be dropped and then use a booster if necessary for dishwashing.

- In kitchens, suggest that the serving and cooking staff avoid keeping infrared food warming lamps on when no food is being kept warm.

CHAPTER 9

CHECKLISTS

In the pages that follow we provide checklists for the various areas discussed in the preceeding sections.

The Building Energy Monitor should go through the building on a regular basis and review these checklist items making notations as appropriate. These notations should be reviewed with the ENCON to insure that these items are addressed.

BUILDING ENERGY MONITOR CHECKLIST

Monitor's Name:

Section and Phone:

Date/Time:

Checklist Item	Location/Remarks
Heating and Cooling	
a. Unused areas and rooms not closed off.	
b. Air conditioners left running.	
c. Air conditioning or heating vents obstructed.	
d. Exterior doors left open.	
e. Windows left open.	
f. Room temperature too high during occupied periods (winter).	
g. Room temperature too high during unoccupied periods (winter).	
h. Room temperature too low during occupied periods (summer).	

Checklist Item	Location/Remarks
i. Room temperature too low during unoccupied periods (summer).	
j. Thermostat damaged.	
k. Fireplace damper open when not in use.	
l. Radiators are dirty.	
m. Air filters need replacing.	
Lighting	
a. Lights left on in unoccupied area.	
b. Lights in use when daylight is sufficient.	
c. Exterior lights on in daytime.	
d. Light levels too high in corridor, stairwells, etc.	
e. Dirt on the surfaces of lamps and/or light reflecting or diffusing surfaces of fixtures.	

Checklist Item	Location/Remarks
f. Lighting in work area exceeds requirements for task (refer to guidelines).	
g. Light bulbs with excessive wattage in use.	
h. Fluorescent lights have been improperly delamped (e.g. ballast is still connected).	
i. Lights over stacks of supplies or equipment.	
j. Frosted incandescent bulbs in use rather than standard clear bulbs.	
k. Excessive exterior illumination.	
l. Walls and/or windows are dirty.	
Other Electrical	
a. Equipment left running when not in use.	
b. Personal heaters/coffee pots in use.	
c. Elevator fan in use.	
d. Inordinate number of elevators in use during weekends, evenings, holidays.	

Checklist Item	Location/Remarks

e. Motor-generator set located in the elevator machine room in use during nights, weekends, holidays.

f. Vending machines on during the weekend where food spoilage is not a problem.

g. Transformer in use when not required for appliance use.

h. Light bulbs removed from vending machines.

Water

a. Leaking faucets.

b. Water flow (gallons/minute) exceeds guidelines.

c. Hosing is being used to clean sidewalks/pavement.

d. Hot water pipe insulation is missing or damaged.

e. Hot water outlet temperature in excess of 110°F.

f. Hot water delivery in prohibited area (e.g., toilets, administrative areas).

Checklist Item	Location/Remarks
g. Steam/water leak in pipes.	
h. Domestic hot water being circulated during unoccupied hours.	
i. Hot water tank is not insulated or insulation is damaged.	
j. Partial load in dish or clothes washers.	
Refrigeration	
a. Refrigeration unit in drinking fountain is in use past the end of normal building hours.	
b. Gaskets around refrigerator doors are not tight.	
c. Refrigerator needs defrosting.	
Building	
a. Broken windows/doors.	
b. Defective fireplace damper.	
c. Misaligned exterior door.	
d. Cracked caulking around windows, doors and exterior joints.	

Checklist Item	Location/Remarks
e. Defective or missing weather stripping around windows and doors.	
f. Shades/curtains are missing on windows.	
g. Outside air intake damper does not close tight.	
h. Exhaust air outlet(s) with no damper(s).	